International Journal of Maxillofacial Prosthetics (iJMP)

CASE REPORT

A customized mono-block brachytherapy appliance for the treatment of mandibular gingival carcinoma: A case report

Mahmoud E. Elbashti, BDS, MDS, PhD[1,2,3], Amel Aswehlee, BDS, MDS, PhD[3], Mariko Hattori, DDS, PhD[1*], Atsushi Kaida, DDS, PhD[4], Yuka Sumita, DDS, PhD[5,6], Noriyuki Wakabayashi, DDS, PhD[1]

[1]Department of Advanced Prosthodontics, Graduate School of Medical and Dental Sciences, Institute of Science Tokyo, Tokyo, Japan.
[2]Faculty of Dentistry, University of Zawia, Zawia, Libya.
[3]Digitodontics International Academy, Bordeaux, France.
[4]Department of Dental Radiology and Radiation Oncology, Graduate School of Medical and Dental Sciences, Institute of Science Tokyo, Tokyo, Japan.
[5]Department of Partial and Complete Denture, The Nippon Dental University, Tokyo, Japan.
[6]Institute of Science Tokyo, Tokyo, Japan.

ARTICLE INFO

Corresponding Author:

Dr. Mariko Hattori

Department of Advanced Prosthodontics, Graduate School of Medical and Dental Sciences, Institute of Science Tokyo,1-5-45 Yushima, Bunkyo-ku, Tokyo 113-8549, Japan.

Phone :+81-3-5803-5556

Email: sasamfp@tmd.ac.jp

Received: 22 March 2025
Received in revised form: 09 April 2025
Accepted: 11 April 2025

ABSTRACT

This case report focuses on customizing a mono-block brachytherapy mold designed for the treatment of mandibular squamous cell carcinoma of the alveolar mucosa in an edentulous patient. A 90-year-old female patient was treated with radioactive gold-198 grains carried by a customized mono-block brachytherapy mold to deliver targeted radiation. A clear acrylic resin mold was designed to ensure precision, stability, and patient comfort, incorporating a chin cap retainer for enhanced retention. The mold's translucency facilitated accurate placement of radioactive gold-198 (^{198}Au) grains, while a lead cavity shielded surrounding tissues. Fabrication involved creating precise grain cavities and securing a lead sheet within the mold. The resulting appliance provided stable and reproducible therapeutic radiation delivery while maintaining functional and anatomical integrity of the mandible. Patient feedback highlighted comfort and compliance. This case highlights the importance of tailoring brachytherapy molds to individual anatomical and clinical needs and emphasizes interdisciplinary collaboration between radiation oncologist and prosthodontists. The approach demonstrates the potential of customized medical devices to optimize outcomes for challenging oncological cases. (*Int J Maxillofac Prosthetics 2025;8:7-11*)

Keywords

Brachytherapy, mandibular gingival carcinoma, custom medical devices, maxillofacial prosthetics, precise radiotherapy.

AUDIOABSTRACTACT

INTRODUCTION

Brachytherapy is a highly targeted radiotherapy approach that utilizes radioactive sources to deliver high dose radiation to the tumor[1] This approach ensures localized and precise treatment by directly inserting radioactive materials into the tissue, positioning them within a body cavity, or applying them to the surface. As a result, brachytherapy minimizes radiation exposure to surrounding healthy tissues while delivering a concentrated dose to the affected area.[2] Over the years, its efficacy and safety have made it a preferred modality for managing various oncological conditions, including oral and maxillofacial malignancies.[3] However, its success heavily relies on the accuracy of source placement and the stability of the applicator used.[2]

Mold brachytherapy is a specific applicator that utilizes a combination of custom-fabricated carrier and a shield that contains lead sheet, referred to as a mold, to deliver ionizing radiation.[2,4] These molds are designed to provide consistent and reproducible geometry, ensuring the precise positioning of radioactive sources throughout the treatment duration.[5] The customization of these devices is essential, as they must fit securely and comfortably to

Articles published in Int J Maxillofac Prosthetics are licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

achieve stability and patient compliance. Furthermore, the adaptability of mold brachytherapy allows clinicians to tailor treatment to the unique anatomical and clinical needs of each patient, particularly in complex areas such as the oral cavity and mandible.

This case report focuses on customizing a mono-block brachytherapy mold designed for the treatment of mandibular squamous cell carcinoma. By detailing the method of customizing a stable, comfortable, and patient-specific appliance, this report aims to provide insights into optimizing the delivery of radiation to the alveolar mucosa of the mandible. In addition, the approach highlights the importance of interdisciplinary collaboration in ensuring effective treatment outcomes for patients requiring precision radiotherapy.

CASE REREPORT

A 90-year-old female patient visited the oral surgery department for the lesion on the right buccal and gingival mucosa (Fig. 1, 2). The lesion exhibited palpable induration. Nineteen years ago, the patient had been diagnosed with cancer in the left and right mandibular gingiva, both of which were surgically resected. Five years later, the patient developed another malignancy on the right mandibular gingiva, which was also surgically removed. As a result of biopsy, the tumor was diagnosed with squamous cell carcinoma Grade 3 (WHO) and YK-3 invasion. The treatment plan was discussed collaboratively between radiation oncologist and maxillofacial prosthodontist. It was decided to make brachytherapy consisting of a total dose of 72 Gy in over 4 days utilizing radioactive gold-198 (^{198}Au) grains carried by a custom-fabricated acrylic resin mold for the right mandibular gingival carcinoma. In addition, a total dose of 77 Gy was prescribed for the buccal mucosa lesion using ^{198}Au grains embedded within the tissue to ensure targeted radiation therapy.

Designing a brachytherapy mold for an edentulous mandible requires careful consideration of several critical factors. Key aspects include the translucency of the fabrication material to ensure visibility, adaptability to the patient's intraoral anatomy, stability during use, and secure retention both intraorally and extraorally. These elements are essential to achieving precise delivery of radiation to the lesion while maintaining patient comfort and ensuring the mold's functionality throughout the treatment process. Building on these key aspects, the mold was designed and fabricated. Impression was taken with a stock tray, impression compound (Modeling Compound, GC) and irreversible hydrocolloid impression material (Algeace, Sankin). The working cast is fabricated by dental stone and jaw relationship was taken using an occlusal base. Wax pattern was fabricated and embeded in a denture flask. A mono-block mold of heat polymerizing

Fig 1. Mandibular squamous cell carcinoma of the alveolar mucosa, intraoral superior view.

Fig 2. Lesion visibility with mold in place.

acrylic resin (Acron clear, GC) was processed in the flask. The mold was polished by using an abrasive paper from #320 to #1000 (Waterproof Abrasive Paper DCC, Sankyo), and then polished on a polishing machine (Kavo EWL Dental Lab Polishing Lathe System, Kavo) by using abrasive powder (NSK Ebisand; Shimomura Gypsum Co, Ltd) with glycerin (Glycerin, Toho). The mold's translucency provided visible access to the lesion, enabling accurate placement of the radioactive grains. Adaptability was ensured through careful customization of the mold to conform to the patient's anatomical features. Stability and retention were achieved fitting in the denture space intraorally and a chin cap retainer extraorally, which provided additional support and minimized movement during therapy.

The mold was tested intraorally to confirm its fitting and retention. The radiation oncologist marked the optimal positions for the radioactive grains on the fabricated mold (Fig. 3). The marked positions were prepared by creating cavities sized in the fitting surfaces of the acrylic resin using a straight round bur (Fig. 4). To shield surrounding tissues from radiation, a curved lead cavity was prepared inside the mold using the bur, after which

Fig 3. Marked position in the mold.

Fig 4. Prepared grain positions in the mold.

a lead sheet was carefully shaped and securely inserted into the cavity (Figs. 5, 6). The lead sheet was subsequently sealed with self-cure acrylic resin (Unifast III clear, GC) to ensure it remained securely in place (Fig. 7). After confirming the space of the cavity for the grains, the radiation oncologist placed the encapsuled 11 ^{198}Au grains (ø 0.8 mm × 2.5 mm, half-life of 2.7 days) into the prepared cavities (Figs. 8,9). They were sealed with wax (Paraffine wax, GC) and the self-cure acrylic resin (Unifast III clear, GC).

After the insertion of 8 ^{198}Au grains in the buccal mucosa, the definitive mold was delivered on the mandibular (Figs. 10, 11). The chin cap retainer further secured the appliance, ensuring minimal displacement during the course of treatment. The patient's feedback indicated satisfactory comfort and stability, which are critical for effective and patient-compliant radiotherapy. After four days of radiation administration, the mold was removed. One-week post-treatment, mucosal inflammation was observed on the mandibular region. The buccal mucosal tumor had softened, though inflammation persisted on the surface. By the third week, the induration had resolved, yet surface inflammation remained. By the fourth week, inflammation showed signs of reduction. Two months post-therapy, only mild inflammation was present. At the four-month follow-up, complete mucosal healing was confirmed for both the buccal and gingival lesions. No recurrence was observed at the treatment site for 18 months post-therapy. The patient was subsequently referred to a local hospital for continued follow-up care.

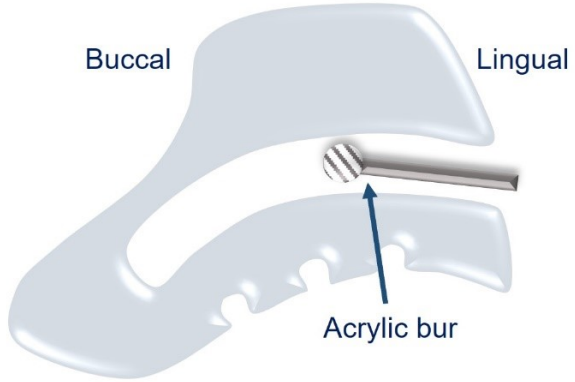

Fig 5. Preparation of lead cavity inside the mold.

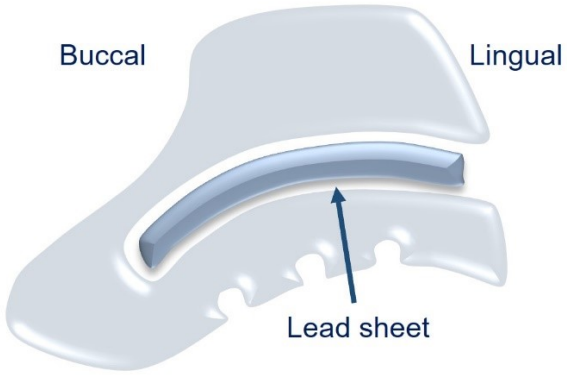

Fig 6. Insertion of lead sheet into the mold.

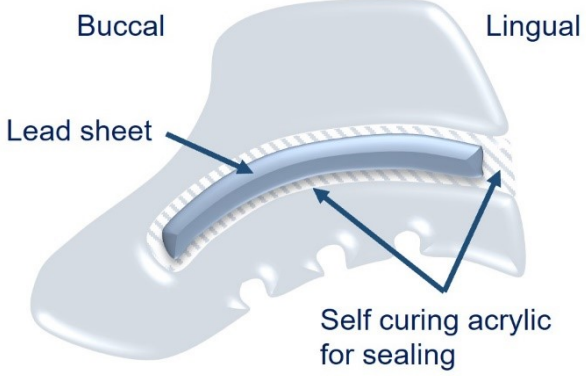

Fig 7. Lead sealed inside the prepared cavity by self-cure acrylic resin.

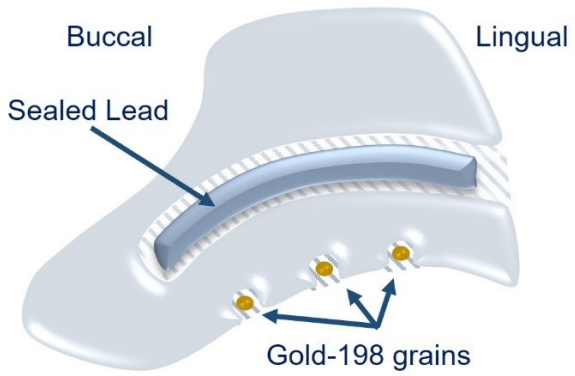

Fig 8. Mold with sealed lead and grains.

Fig 9. Radioactive grains in place.

DISCUSSION

Brachytherapy is an important treatment modality available to clinicians for the management of mandibular mucosa tumors.[6] One of the primary advantages of brachytherapy is its ability to avoid surgical intervention, thus preserving the normal anatomical structure and functional integrity of the mandible. This approach not only minimizes morbidity associated with surgery but also enhances the quality of life for patients by maintaining their ability to perform essential functions such as chewing and speaking.[2] Moreover, the localized nature of brachytherapy allows for a targeted therapeutic effect, reducing the probability of adverse effects on surrounding healthy tissues.[7]

The rapid dose delivery achieved through brachytherapy is another critical advantage. By concentrating the radiation around the radioactive source, the treatment effectively controls the tumor while sparing adjacent normal tissues.[8] This precision significantly reduces the risk of collateral damage and associated complications. In addition, the shorter overall treatment duration inherent to brachytherapy minimizes the chance for tumor progression or spread, making it an efficient option for managing aggressive lesions.[4] These benefits highlight the importance of ensuring precise and stable placement of the brachytherapy mold, as any deviation could compromise treatment efficacy.

In cases involving the maxilla, twin-block brachytherapy appliances are commonly employed due to the anatomical complexity and need for stability. However, the unique challenges posed by edentulous mandibular lesions necessitate innovative solutions. In this case, the fabrication of a mono-block brachytherapy mold addressed these challenges effectively. The preparation of the lead cavity and the horizontal insertion of the lead sheet were key steps in creating a mold that was both adaptable and functional. The subsequent addition of a protective lead sheet, while maintaining the mold's translucency, ensured that the radioactive grain positions could be determined with precision.

Fig 10. Definitive mold.

Fig 11. Intraoral view for the definitive mold in place.

A key innovation in this study was the fabrication of the mold as a single unit without incorporating the lead shielding initially. Traditionally, the mold consists of two separate components: a carrier containing the radioactive grains and a shield containing lead. The conventional approach requires trying the carrier intraorally first to mark the grain placement before

mechanically assembling the shield. However, when the shield is pre-attached, it obstructs visibility, preventing accurate marking of grain positions. By fabricating the mold as a single unit and subsequently inserting the lead shielding, this approach allowed for improved visibility during the marking phase while also simplifying intraoral handling. This method was particularly advantageous for an edentulous lower jaw, where conventional two-part prostheses often present stability challenges. The improved mold design enhanced usability, stability, and overall treatment precision.

The translucency of the mono-block mold played a crucial role in this case. By allowing visual access to the lesion, it facilitated accurate placement of the radioactive grains, thereby maximizing the therapeutic impact. Furthermore, the use of clear acrylic resin ensured that the mold could be easily evaluated for fit and adaptability during the fabrication process. Stability and retention were enhanced through the use of intraoral undercut engagement and an extraoral chin cap retainer. This dual retention strategy minimized the risk of displacement during treatment, ensuring consistent radiation delivery to the target site.

The decision to utilize a mono-block mold for the edentulous mandible highlights the importance of tailoring brachytherapy devices to individual patient needs. By addressing issues of adaptability, stability, and retention, this approach exemplifies how personalized medical devices can optimize treatment outcomes. This case also emphasizes the significance of interdisciplinary collaboration between radiation oncologist and prosthodontists in designing and implementing effective brachytherapy solutions. Such teamwork ensures that all aspects of the patient's clinical and anatomical requirements are considered, ultimately enhancing the success of the treatment.

CONCLUSION

This case report demonstrates the successful application of a customized mono-block brachytherapy mold for the treatment of mandibular squamous cell carcinoma of the alveolar mucosa in an edentulous patient. The innovative design of the mold, incorporating clear acrylic resin for visibility and a protective lead sheet for shielding, ensured precise placement and stable retention throughout the treatment. By addressing the unique anatomical and clinical challenges of the mandible, this approach highlights the critical role of customized medical devices in optimizing therapeutic outcomes.

Furthermore, the collaboration between radiation oncologist and prosthodontists underscores the importance of interdisciplinary teamwork in delivering effective and patient-centered care.

REFERENCES

1. Babu S, Krishnan M. Radiant advances: The future of brachytherapy in oral oncology. Oral Oncology Reports. 2024;12:100654.
2. Taniguchi H. Radiotherapy prostheses. J Med Dent Sci 2000;47:12-26.
3. Hernandez R, Jackson S, Miller A. Multimodal treatment strategies in oral cancers: the role of brachytherapy. Oral Oncol. 2023;149:105354.
4. Garcia R, Patel K. Personalized approaches in brachytherapy for head and neck cancers. Brachytherapy J, 2023;12: 123-130.
5. Takeda M, Shibuya H, Inoue T. The efficacy of gold-189 grain mold therapy for mucosal carcinomas of the oral cavity. Acta Oncologica1996;35: 463-467.
6. Kumar N, Sharma P, Gupta S. Current perspectives on brachytherapy in the management of oral cancers. J Contemp Brachytherapy. 2023;15:56-63.
7. Mazeron R, Tao Y, Lusinchi A, Bourhis J. Brachytherapy for head and neck cancers. Radiother Oncol. 2019;148:60-66.
8. Rosenblatt E, Gerard JP, McLaughlin PW. Brachytherapy in the management of head and neck cancers. Semin Radiat Oncol. 2020;30:292-301.